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1991 Rivers Inlet Echo Sounding Program Summary Report

I. Winther

Department of Fisheries and Oceans
Fisheries Branch
Prince Rupert, B.C.
V8J 1G8

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ABSTRACT

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Sockeye salmon escapement past the Rivers Inlet (Department of Fisheries and Oceans, Statistical Area 9) commercial fishery is monitored by an echo sounding program conducted at the head of the inlet. This report summarizes the field data collected during the 1991 Rivers Inlet echo sounding program.

RESUME

Winther, I. 1991. 1991 Rivers Inlet echo sounding program: summary report. Can. Data Rep. Fish. Aquat. Sci. 858: iii + 21 p.

La peche commerciale du saumon sockeye qui remonte le bras de mer Rivers (ministere des Peches et des Oceans, secteur statistique no 9) est controlee au moyen d'un systeme d'echo-sondage mis en place a l'extremite du bras de mer. Ce rapport recapitule les donnees fournies par le programme d'echo-sondage du bras de mer Rivers durant 1991.

INTRODUCTION

Rivers Inlet is located in the Central Coast area of British Columbia within Statistical Area 9 as described by the Department of Fisheries and Oceans, Canada (Fig. 1). Rivers Inlet sockeye represent the largest stock of sockeye returning to the Central Coast. The Wannock River and the tributaries of Owikeno Lake are the spawning grounds for the majority of Rivers Inlet sockeye. Owikeno Lake provides additional spawning capacity and is the main rearing area for sockeye fry. The Wannock River drains Owikeno Lake into Rivers Inlet.

After passing through the Rivers Inlet fishing area (management subareas 9-2,3,4 & 11) adult sockeye tend to hold at the head of the inlet before continuing up the Wannock River. Wood and Mason (1971) determined that the Rivers Inlet sockeye stock size could be estimated using hydroacoustic techniques.

Goruk and Thomson (1988) and Wood and Mason (1971) discussed characteristics of the Rivers Inlet sockeye salmon stock used in determining the hydroacoustic sampling procedure. Dense daytime schools of sockeye ascend and disperse at night allowing individual salmon targets to be distinguished on an echogram. Most of the targets (95 to 99%) are found in the top 10 fathoms. Adult salmon tend to avoid the freshwater layer that exists at the surface of the inlet thus minimizing vessel avoidance to some extent.

The Rivers Inlet Echo Sounding Program has been operated since 1967. Data collected during the program is used in season to provide information for management of the commercial sockeye fishery.

METHODS

The Rivers Inlet Echo sounding program was conducted from July 9 to July 24, 1991. The Walker Rock, a 12 m seine vessel belonging to the Department of Fisheries and Oceans, was used for the program. The Walker Rock was equipped with a Simrad EY-M dry paper recorder and a Simrad 74AA/AP (70 kHz) transducer with a beam angle of 30 degrees. The Simrad EY-M recorder was operated at settings of Gain = 9 and Time-varied Gain (TVG) = 40 log R. A Furuno color echo sounder was used when navigating to and from the grid site. The echo sounders were used individually because of interference created when both units were operated. No quantitative data was collected with the Furuno color echo sounder.

It was possible to use a Wesmar HD series sonar simultaneously with the Simrad EY-M without interference. The echogram produced by the Wesmar in sounding mode was almost identical to that of the Simrad. The only exception was a very slight difference in the presence and absence of targets near the surface probably due to the different positions of the sonar dome and the sounder transducer. After calibrating the Wesmar in sounding mode it was possible to use the sonar mode to find and track fish. No quantitative data was collected with the Wesmar sonar.

Eleven transects were sounded nightly. In Figure 2 the Miss Robyn grid is represented by transects 1 to 6 and the R.D. 102 grid is represented by transects A to E. Sounding began after dusk at the head of the inlet and continued seaward to the last transect off McAllister Point. Soundings were completed before dawn. Soundings were initiated and terminated one cable (180 m) from the beach. The echogram was marked at the start and end of each transect. The duration of each transect was timed with a stopwatch. The engine speed of the Walker Rock was kept at 800 R.P.M. during transects.

Targets on the echogram were counted in five depth divisions between 1 and 10 m. The depth divisions were 1-2 m, 2-3 m, 3-5 m, 5-7 m, and 7-10 m.

Calculations for estimating sockeye abundance from echosounding counts are described by Goruk and Thomson (1988). A micro computer was used to perform the calculations.

RESULTS & DISCUSSION

Sockeye populations in the grid area as estimated by the echo sounding program are presented in Table 1 and Figure 3. Very few targets were observed during the first six nights of echo sounding July 9/10 to 14/15. The first group of fish estimated at approximately 20,000 were observed on the R.D. 102 grid on July 15/16. The following night the majority of the targets were observed on the Miss Robyn grid without an appreciable change in abundance (23,250 estimate for both grids). Subsequent declines were observed in both grids to a low total of 14,270 on the night of July 18/19. A body of fish began moving onto the grids about July 20. The maximum estimate of 209,765 for both grids was reached on the last night of the program, July 23/24.

Weather and transect time data appear in the field notes. The paucity of information on fish observations (ie. jumpers and targets on the color sounder) this year was not a result of changes in methods or recording, there were simply very few fish observed.

There were five commercial gillnet fisheries directed at Rivers Inlet sockeye in 1991. Three 48 hour openings were held beginning at 1800 hours of June 30, July 7 and July 14 followed by two 24 hour openings beginning at 1800 hours of July 21 and 28. Management subareas 9-2,3,4 and 11 were opened to fishing gillnets with a maximum mesh restriction of 150 mm. A 24 hour gillnet fishery directed at chum salmon stocks began at 1800 hours August 11. The fishery was held in subareas 9-2,3 and 4 with gillnets restricted to a minimum mesh size of 149 mm. Total sockeye catch in Area 9 in 1991 was 152,241. Catches are presented in Table 2.

The Owekeno Band harvested food fish from the Wannock River and the head of Rivers Inlet by gillnet. Total catch to September 14, 1991 was 1020 sockeye, 1 coho and 1 steelhead.

Table 3 presents age data from sockeye scale samples collected from the commercial gillnet catch. Age 5_2 sockeye make up 70.9 % of the population and age 4_2 sockeye make up 24.3 %.

A tide table for Wadhams, Rivers Inlet is presented in Appendix 1 for the period July 1 to August 15, 1991. Tidal extremes are graphed in Figure 4.

Appendix 2 compares 1991 soundings to historic echo sounding work in Rivers Inlet (Goruk & Thomson, 1988; Winther, 1989; Winther, 1990).

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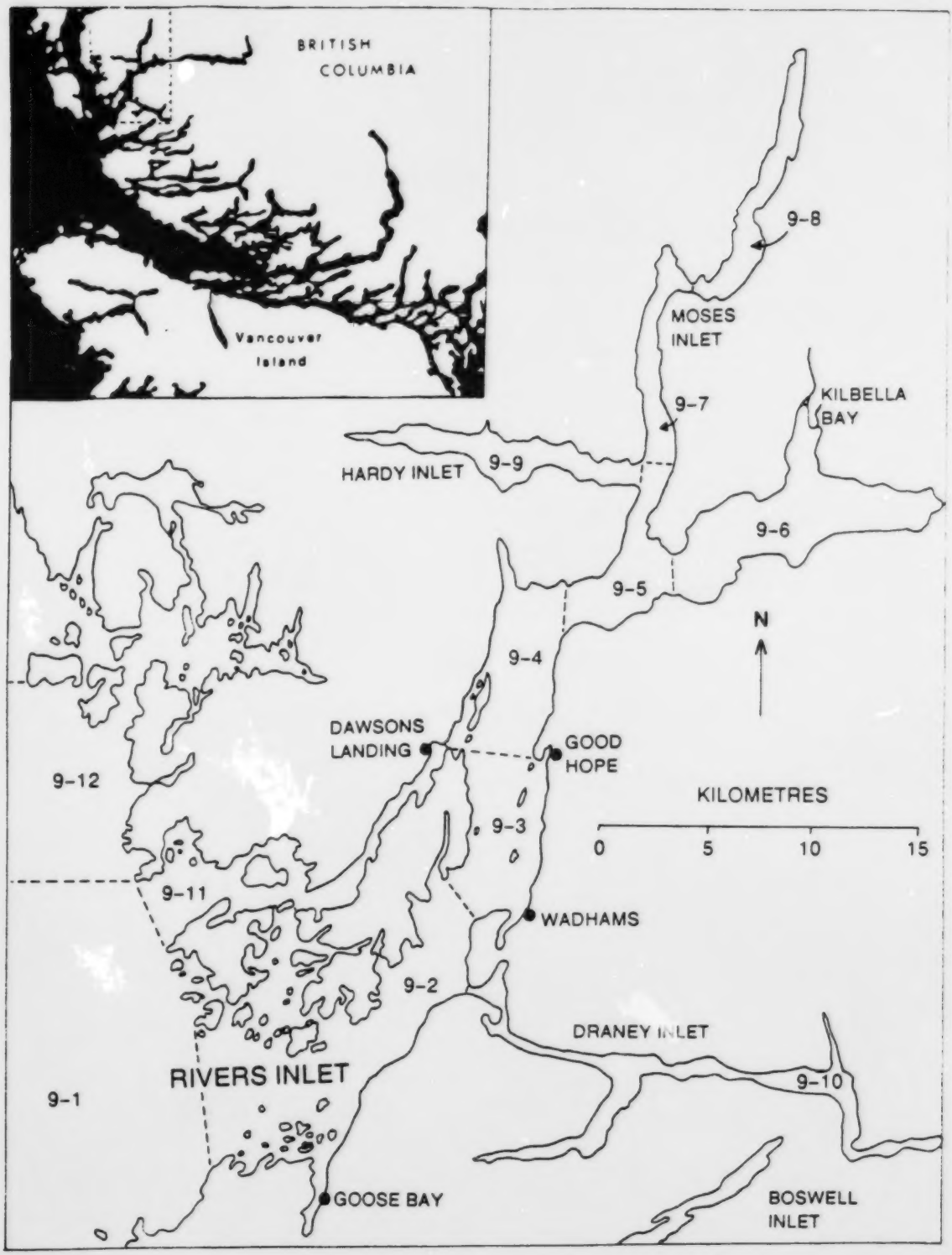


FIGURE 1. Rivers Inlet (Statistical Area 9), British Columbia.

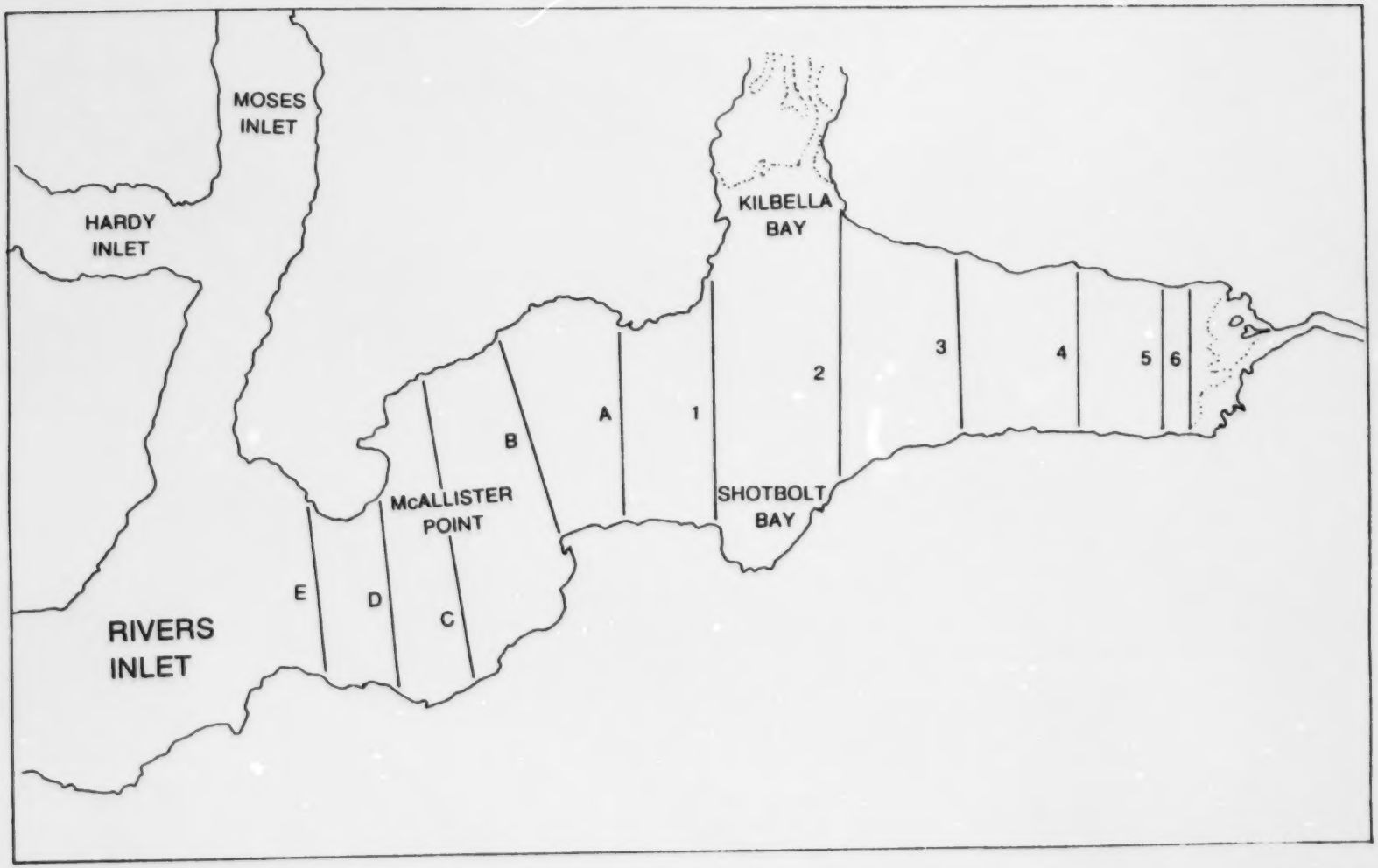


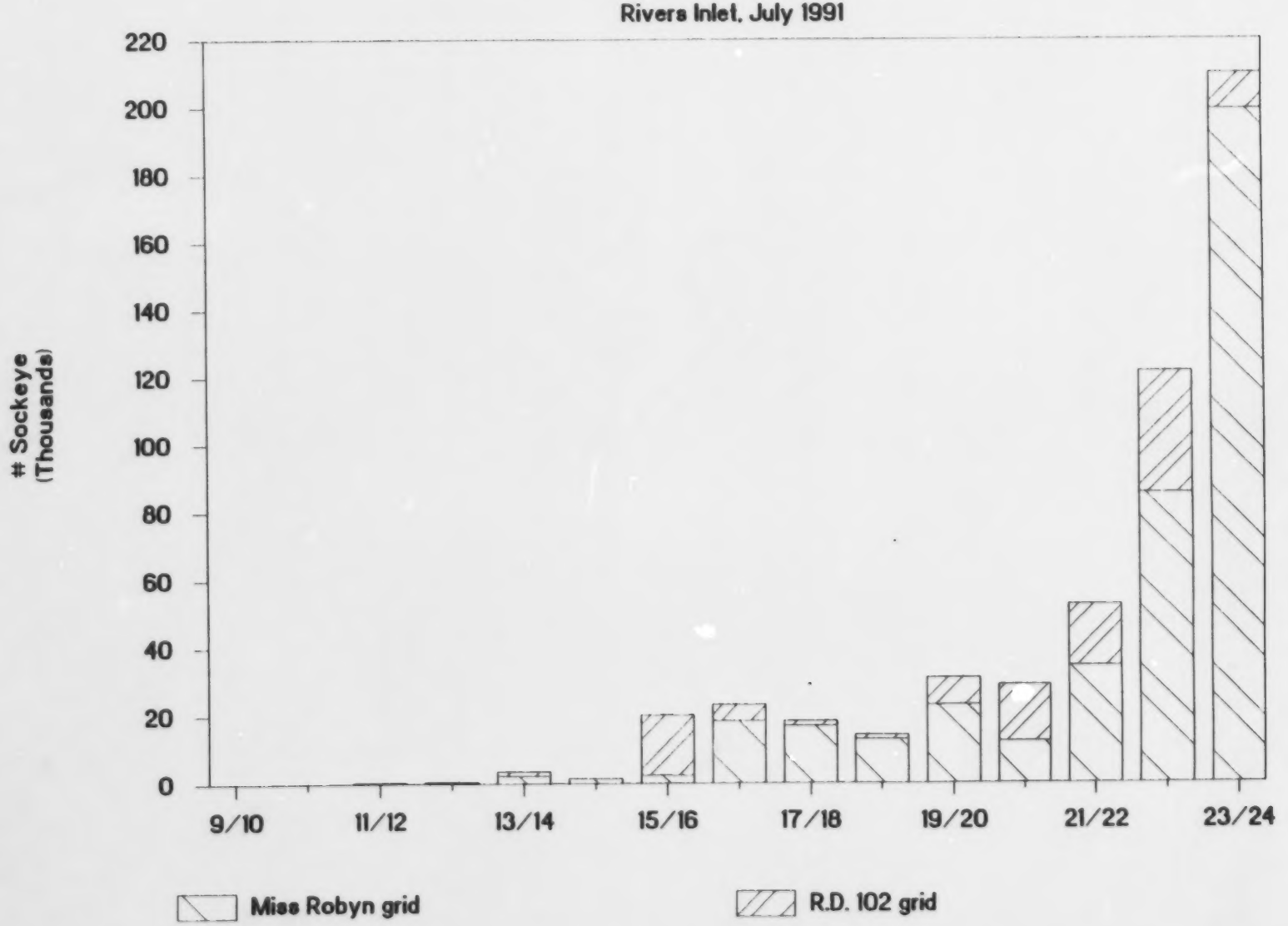
FIGURE 2. Miss Robyn Grid and R.D. 102 Grid, Rivers Inlet.

Table 1: 1991 ECHO SOUNDING RESULTS

DATE	MISS ROBYN GRID 6	5	4	3	2	1	TOTAL MISS ROBYN	RD 102 GRID A	B	C	D	E	TOTAL RD 102 GRID	TOTAL ALL GRIDS
JULY 9/10	0	0	0	0	0	0	0	0	0	0	0	0	0	0
JULY 10/11	0	0	0	0	0	0	0	0	0	0	0	0	0	0
JULY 11/12	0	0	0	0	0	0	0	0	0	434	0	0	434	434
JULY 12/13	0	139	0	0	0	0	139	0	0	0	414	0	414	553
JULY 13/14	0	0	0	0	2298	0	2298	0	0	723	0	427	1149	3447
JULY 14/15	185	334	893	0	0	0	1412	0	0	0	0	0	0	1412
JULY 15/16	286	0	0	0	0	2273	2559	3887	6655	1699	3401	2104	17745	20304
JULY 16/17	990	754	2457	5719	5143	3438	18501	539	815	2566	829	0	4749	23250
JULY 17/18	864	3986	5114	7082	0	0	17047	0	0	732	0	568	1291	18338
JULY 18/19	131	517	4467	5488	2011	437	13052	857	0	362	0	0	1218	14270
JULY 19/20	876	2398	6078	5984	4596	3205	23137	2853	1738	1301	950	1236	8078	31215
JULY 20/21	0	3123	6571	1017	1150	437	12297	2112	4863	4284	2970	2558	16787	29084
JULY 21/22	1001	3427	6796	14345	6181	3177	34746	1551	1331	5675	3316	6098	17970	52716
JULY 22/23	1281	17874	33361	11238	17385	4518	85657	7417	2527	6027	12231	7820	36066	121723
JULY 23/24	619	906	23616	158832	12787	2538	199298	3821	1279	3254	1900	213	10467	209765

#'S MAY DIFFER SLIGHTLY FROM FIELD SHEET TOTALS DUE TO ROUNDING ERRORS

Figure 3: Echosounding Estimates



1991 Rivers Inlet Echo Sounding Program Field Notes:

The following notes record the times each transect was run, weather conditions and sightings of fish. Transect run times have been collected for correlation with tidal information. Times of the start and end of each transect are presented to the nearest minute (local time, 24 hour clock). The exact duration of each transect was recorded with a stop watch for use in calculations of fish density and are presented in two formats; minutes and seconds and total seconds.

Central Coast Biologist, Ivan Winther conducted the echo sounding. Captain Robert E. Davis operated the Department of Fisheries and Oceans vessel Walker Rock which acted as the sounding platform. The main engine was run at 800 RPM during each transect. The Simrad EY-M paper sounder was operated at a gain of 9 and a time varied gain (TVG) of 40 log R.

There were very few observations of fish (either jumpers, finners or targets on the color sounder) early in the program.

JULY 9/10 Depart Dawsons 2100, return 0345. Weather 10% cloud, wind W 10-15 kn. Several large targets around 20 fm near McPhee Bay.

		START (hr:min)	END (hr:min)	DURATION (min:sec)	DURATION (sec)
Miss Robyn	6	22:54	23:02	08:25	505
	5	23:03	23:15	12:21	741
	4	23:24	23:37	12:23	743
	3	23:42	23:57	14:21	861
	2	00:02	00:22	19:24	1164
	1	00:30	00:51	21:16	1276
R.D. 102	A	00:59	01:13	14:06	846
	B	01:19	01:32	13:11	791
	C	01:37	01:58	20:55	1255
	D	02:03	02:18	15:50	950
	E	02:24	02:36	12:08	728

JULY 10/11 Depart Dawsons 2050, return 0330. Weather 90% overcast, calm. Large targets deep (20 fm) on the R.D 102 transects.

Miss Robyn	6	22:41	22:50	08:38	518
	5	22:51	23:01	09:54	594
	4	23:06	23:19	12:15	735
	3	23:24	23:38	13:26	806
	2	23:44	00:05	21:20	1280
	1	00:11	00:30	18:52	1132
R.D. 102	A	00:39	00:53	13:50	830
	B	00:57	01:10	13:11	791
	C	01:15	01:37	22:12	1332
	D	01:42	01:56	14:03	843
	E	02:02	02:14	11:00	660

JULY 11/12 Depart Dawsons 2050, return 0330. Weather overcast, hard rain in the morning, rain squalls after 2400, wind SW 0-5 kn. First five jumpers observed between Dawsons and Stone Point. Several deep targets on the R.D. 102 grid.

Miss Robyn	6	22:37	22:45	08:01	481
	5	22:46	22:55	09:12	552
	4	23:00	23:12	11:18	678
	3	23:17	23:31	13:10	790
	2	23:37	23:57	20:14	1214
	1	00:02	00:22	19:54	1194
R.D. 102	A	00:30	00:44	14:22	862
	B	00:48	01:01	12:59	779
	C	01:06	01:27	20:34	1234
	D	01:32	01:45	13:02	782
	E	01:53	02:04	10:57	657

JULY 12/13 Depart Dawsons 2045, return 0320. Weather overcast, foggy at the head of the inlet, rain, wind SW 0-5 kn. Very poor visibility due to fog and rain. Lots of logs and debris in the inlet. Deep targets on the 2 outside transects.

Miss Robyn	6	22:30	22:38	07:58	478
	5	22:39	22:48	08:39	519
	4	22:52	23:04	11:29	689
	3	23:09	23:22	13:18	798
	2	23:33	23:54	21:06	1266
	1	23:59	00:20	20:25	1225
R.D. 102	A	00:29	00:42	13:17	797
	B	00:46	00:58	12:48	768
	C	01:04	01:25	21:13	1273
	D	01:31	01:44	13:48	828
	E	01:49	01:59	09:33	573

JULY 13/14 Depart Dawsons 2040, return 0320. Weather overcast, showers, wind SE 0-5 kn. Four targets between transects 5 and 6 on the south shore.

Miss Robyn	6	22:34	22:42	07:55	475
	5	22:43	22:51	08:19	499
	4	22:57	23:08	11:08	668
	3	23:12	23:25	12:47	767
	2	23:32	23:53	20:22	1222
	1	23:58	00:15	17:16	1036
R.D. 102	A	00:23	00:37	13:26	806
	B	00:41	00:54	13:14	794
	C	00:59	01:21	21:03	1263
	D	01:26	01:41	14:24	864
	E	01:45	01:56	10:49	649

JULY 14/15 Depart Dawsons 1845, return 0400. Weather low overcast, rain, wind NE 5-15 kn. Areas 9-2,3,4 & 11 open to commercial fishing by gillnet and troll at 1800. Departed early to get by the nets. Several deep targets between transects 4 and 5.

Miss Robyn	6	22:30	22:37	08:01	481
	5	22:38	22:48	09:14	554
	4	22:54	23:04	10:40	640
	3	23:09	23:21	12:41	761
	2	23:28	23:49	21:16	1276
	1	23:55	00:14	18:50	1130
R.D. 102	A	00:22	00:35	13:02	782
	B	00:38	00:51	13:00	780
	C	00:56	01:17	20:59	1259
	D	01:22	01:38	15:12	912
	E	01:42	01:53	11:06	666

JULY 15/16 Depart Dawsons 2015, return 0430. Weather low overcast, rain, wind NE 0-5 kn. Commercial fishery still open. Six targets at 3 to 5 fm in Shotbolt Bay. Most targets concentrated on the south side of the inlet.

Miss Robyn	6	22:45	22:53	08:11	491
	5	22:54	23:03	09:39	579
	4	23:09	23:20	11:15	675
	3	23:25	23:38	13:01	781
	2	23:44	00:05	20:49	1249
	1	00:10	00:29	19:12	1152
R.D. 102	A	00:36	00:51	13:48	828
	B	00:53	01:06	12:42	762
	C	01:11	01:34	23:00	1380
	D	01:40	01:55	14:49	889
	E	02:01	02:13	11:12	672

JULY 16/17 Depart Dawsons 2045, return 0330. Weather 90% cloud, rain during the day, wind W 0-5 kn. Commercial fishery closed at 1800. Observed 2 schools on the color sounder off of Stone point at 2130.

Miss Robyn	6	22:34	22:43	08:36	516
	5	22:44	22:54	09:54	594
	4	22:59	23:11	11:27	687
	3	23:15	23:30	14:12	852
	2	23:36	23:57	20:19	1219
	1	00:03	00:20	17:39	1059
R.D. 102	A	00:28	00:42	14:38	878
	B	00:45	01:00	13:55	835
	C	01:05	01:27	21:52	1312
	D	01:31	01:46	14:26	866
	E	01:51	02:02	10:43	643

JULY 17/18 Depart Dawsons 2100, return 0330. Weather 50% cloud, wind W 0-5 kn. Eleven targets between transects 4 and 5.

Miss Robyn	6	22:53	23:02	09:24	564
	5	23:03	23:14	10:52	652
	4	23:20	23:31	11:35	695
	3	23:36	23:49	12:54	774
	2	23:55	00:17	21:20	1280
	1	00:22	00:41	18:20	1100
R.D. 102	A	00:48	01:03	14:39	879
	B	01:06	01:19	12:59	779
	C	01:23	01:46	23:13	1393
	D	01:51	02:05	14:26	866
	E	02:09	02:20	10:12	612

JULY 18/19 Depart Dawsons 2045, return 0300. Weather low overcast, showers, wind W 0-5 kn.

Miss Robyn	6	22:40	22:48	08:10	490
	5	22:49	22:59	10:02	602
	4	23:05	23:17	11:43	703
	3	23:22	23:34	12:39	759
	2	23:40	00:01	20:52	1252
	1	00:07	00:25	18:03	1083
R.D. 102	A	00:33	00:47	13:52	832
	B	00:50	01:04	13:38	818
	C	01:08	01:28	19:42	1182
	D	01:33	01:48	14:56	896
	E	01:53	02:03	10:26	626

JULY 19/20 Depart Dawsons 2045, return 0300. Weather overcast, wind W 0-10 kn. The first sockeye were reported in the Wannock River seine tests this morning. Observed several targets between transects 4 and 5 and 2 jumpers off of Stone Point.

Miss Robyn	6	22:41	22:49	08:23	503
	5	22:50	23:00	09:32	572
	4	23:05	23:17	11:56	716
	3	23:22	23:35	13:30	810
	2	23:42	00:02	20:04	1204
	1	00:08	00:26	17:53	1073
R.D. 102	A	00:32	00:46	13:42	822
	B	00:49	01:03	14:13	853
	C	01:07	01:27	19:56	1196
	D	01:32	01:47	15:01	901
	E	01:51	02:00	09:33	573

JULY 20/21 Depart Dawsons 2045, return 0315. Weather overcast, rain showers, calm. Saw a few finners and 2 jumpers in Darby channel, 40 jumpers from Darby channel to Browns Bay. Perfect viewing conditions.

Miss Robyn	6	22:37	22:44	07:40	460
	5	22:45	22:55	09:29	569
	4	23:00	23:12	11:49	709
	3	23:17	23:31	13:15	795
	2	23:38	23:59	21:09	1269
	1	00:04	00:22	18:00	1080
R.D. 102	A	00:28	00:42	13:27	807
	B	00:44	00:58	13:58	838
	C	01:03	01:24	19:54	1194
	D	01:28	01:42	14:01	841
	E	01:46	01:57	11:31	691

JULY 21/22 Depart Dawsons 1900, return 0400. Weather overcast in the morning, clear after noon, wind W 0-5 kn. Bright 3/4 moon after 2200. Commercial fishery open at 1800. 147 gillnetters in area 9-4, 357 gillnetters in all of area 9. Approximately 40 jumpers inside of Stone Point. A couple of schools on the colored sounder.

Miss Robyn	6	22:30	22:38	08:00	480
	5	22:39	22:48	09:27	567
	4	22:54	23:06	11:54	714
	3	23:11	23:25	14:00	840
	2	23:32	23:52	19:50	1190
	1	23:58	00:16	18:32	1112
R.D. 102	A	00:23	00:37	13:38	818
	B	00:40	00:53	13:08	788
	C	00:57	01:20	22:48	1368
	D	01:25	01:40	14:36	876
	E	01:44	01:55	11:25	685

JULY 22/23 Depart Dawsons 1900, return 0330. Weather clear, wind W 5-10 kn., calm after 2300, NE outflow 5-15 kn. after 2400. Bright 3/4 moon. Commercial fishery closed at 1800. Approximately 50 jumpers between Stone Point and the R.D. 102 grid. Very few jumpers on the grid. Heavy concentration of targets between transects 4 and 5 on the north side of the inlet. Targets were clumped and difficult to count on transects 4 and 5.

Miss Robyn	6	22:38	22:47	08:24	504
	5	22:48	22:57	09:31	571
	4	23:03	23:14	11:35	695
	3	23:19	23:32	12:52	772
	2	23:40	23:59	18:56	1136
	1	00:05	00:23	18:09	1089
R.D. 102	A	00:29	00:44	14:32	872
	B	00:47	00:59	11:53	713
	C	01:02	01:22	19:26	1166
	D	01:27	01:42	15:16	916
	E	01:46	01:57	10:45	645

JULY 23/24 Depart Dawsons 2100, return 0345. Weather 20% cloud, clear most of the day, wind W 0-5 kn. Heavy concentration of targets near Rivers Inlet Resort. 20 to 30 jumpers on the grid.

Miss Robyn	6	22:51	22:59	08:03	483
	5	23:00	23:09	09:37	577
	4	23:16	23:28	12:07	727
	3	23:33	23:46	12:22	742
	2	23:52	00:12	19:24	1164
	1	00:18	00:35	16:36	996
R.D. 102	A	00:41	00:56	14:19	859
	B	01:59	01:12	12:57	777
	C	01:17	01:37	20:27	1227
	D	02:42	01:57	14:20	860
	E	00:01	02:13	12:33	753

Table 2: AREA 9 GILLNET FIELD CATCH FIGURES - 1991

Date	Opr.	Sockeye	Coho	Pink	Chum	Chin.	Jack	Sthd.
01-Jul	249	1420	491	0	253	279	242	4
02-Jul	212	1982	736	6	600	228	47	0
TFW	461	3402	1227	6	853	507	289	4
TTD	461	3402	1227	6	853	507	289	4
08-Jul	145	4407	216	10	151	169	39	1
09-Jul	145	5925	216	13	233	160	63	2
TFW	290	10332	432	23	384	329	102	3
TTD	751	13734	1659	29	1237	836	391	7
15-Jul	261	53773	151	14	282	67	11	1
16-Jul	199	11810	123	23	318	43	22	1
TFW	460	65583	274	37	600	110	33	2
TTD	1211	79317	1933	66	1837	946	424	9
22-Jul	357	47674	169	199	593	139	42	0
TFW	357	47674	169	199	593	139	42	0
TTD	1568	126991	2102	265	2430	1085	466	9
29-Jul	328	25230	565	2014	2036	226	32	0
TFW	328	25230	565	2014	2036	226	32	0
TTD	1896	152221	2667	2279	4466	1311	498	9
12-Aug	3	20	33	25	184	3	1	0
TFW	3	20	33	25	184	3	1	0
TTD	1899	152241	2700	2304	4650	1314	499	9

Table 3: 1991 RIVERS INLET SOCKEYE SCALE SAMPLES

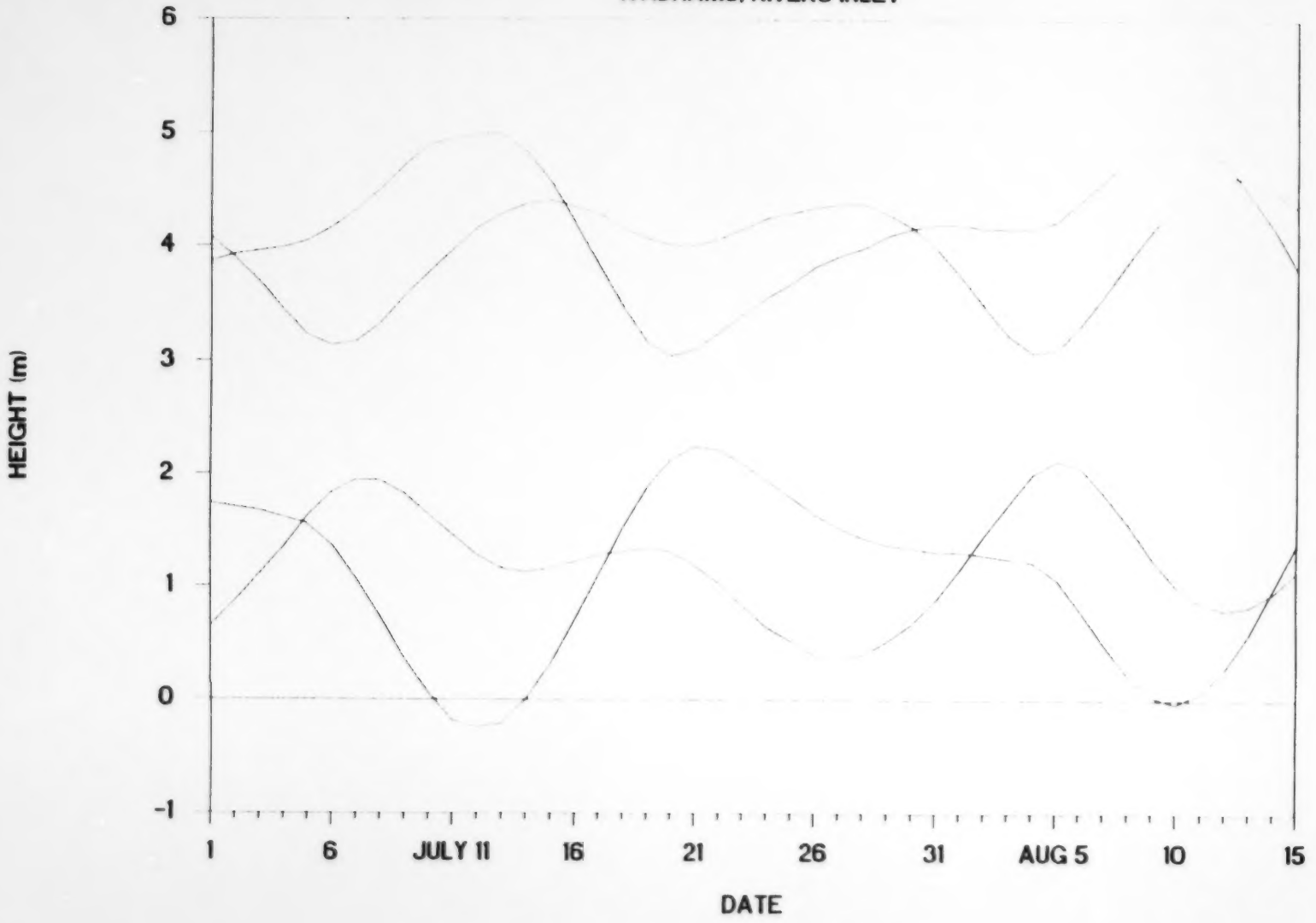
		AGE						
DATE	TOTAL	3(1)	4(1)	4(2)	4(3)	5(2)	6(2)	6(3)
01-Jul-91	5			4		1		
02-Jul-91	64	1	3	16	1	40		3
08-Jul-91	106		1	13		84	1	7
15-Jul-91	286	2		38		118		
22-Jul-91		1	1	22		46		
29-Jul-91			1	19		38		
TOTAL	461	4	6	112	1	327	1	10
%	100.0%	0.9%	1.3%	24.3%	0.2%	70.9%	0.2%	2.2%

Note: Data collected from commercial gillnet fisheries.

Appendix 1: 1991 TIDE HEIGHTS AT WADHAMS, RIVERS INLET.

Date	Time (PST)	Height (ft)	(m)	Date	Time (PST)	Height (ft)	(m)	Date	Time (PST)	Height (ft)	(m)
JULY 1	02:42	13.4	4.1	JULY 16	03:37	13.8	4.2	AUG 1	03:42	12.3	3.7
	09:23	2.1	0.6		10:03	2.3	0.7		09:53	3.8	1.2
	15:42	12.7	3.9		16:22	14.3	4.4		16:07	13.8	4.2
	21:38	5.7	1.7		22:43	4.0	1.2		22:43	4.3	1.3
JULY 2	03:22	12.8	3.9	JULY 17	04:32	12.6	3.8	AUG 2	04:32	11.4	3.5
	09:53	2.8	0.9		10:43	3.6	1.1		10:28	4.8	1.5
	16:17	12.9	3.9		17:07	14.1	4.3		16:52	13.7	4.2
	22:23	5.6	1.7		23:48	4.2	1.3		23:43	4.2	1.3
JULY 3	04:07	12.1	3.7	JULY 18	05:32	11.4	3.5	AUG 3	05:37	10.6	3.2
	10:28	3.6	1.1		11:28	5.0	1.5		11:13	5.7	1.7
	16:57	13.0	4.0		17:57	13.7	4.2		17:42	13.7	4.2
	23:18	5.5	1.7	JULY 19	00:53	4.4	1.3	AUG 4	00:53	4.0	1.2
JULY 4	04:57	11.3	3.4		06:42	10.4	3.2		06:57	10.1	3.1
	11:08	4.4	1.3		12:23	6.2	1.9		12:18	6.6	2.0
	17:37	13.1	4.0		18:52	13.4	4.1		18:47	13.7	4.2
JULY 5	00:18	5.1	1.6	JULY 20	02:08	4.3	1.3	AUG 5	02:13	3.5	1.1
	06:02	10.6	3.2		08:12	10.0	3.0		08:37	10.2	3.1
	11:58	5.3	1.6		13:28	7.0	2.1		13:38	7.0	2.1
	18:27	13.3	4.1		19:52	13.2	4.0		20:02	13.9	4.2
JULY 6	01:28	4.5	1.4	JULY 21	03:13	3.9	1.2	AUG 6	03:28	2.6	0.8
	07:22	10.3	3.1		09:37	10.2	3.1		09:52	10.9	3.3
	12:58	6.0	1.8		14:43	7.4	2.3		15:08	6.8	2.1
	19:27	13.7	4.2		20:52	13.2	4.0		21:12	14.5	4.4
JULY 7	02:38	3.5	1.1	JULY 22	04:13	3.4	1.0	AUG 7	04:28	1.6	0.5
	08:52	10.4	3.2		10:42	10.7	3.3		10:52	11.8	3.6
	14:08	6.4	2.0		15:53	7.3	2.2		16:18	6.0	1.8
	20:27	14.2	4.3		21:47	13.4	4.1		22:17	15.1	4.6
JULY 8	03:43	2.4	0.7	JULY 23	05:03	2.7	0.8	AUG 8	05:23	0.7	0.2
	10:02	10.9	3.3		11:27	11.2	3.4		11:42	12.8	3.9
	15:18	6.4	2.0		16:48	6.9	2.1		17:18	5.1	1.6
	21:27	14.8	4.5		22:37	13.7	4.2		23:12	15.8	4.8
JULY 9	04:43	1.2	0.4	JULY 24	05:43	2.1	0.6	AUG 9	06:08	0.1	0.0
	11:02	11.7	3.6		12:02	11.7	3.6		12:22	13.7	4.2
	16:23	6.0	1.8		17:33	6.4	2.0		18:08	4.1	1.2
	22:27	15.5	4.7		23:22	14.0	4.3	AUG 10	00:07	16.1	4.9
JULY 10	05:33	0.2	0.1	JULY 25	06:18	1.7	0.5		06:53	-0.1	0.0
	11:57	12.4	3.8		12:37	12.1	3.7		13:02	14.4	4.4
	17:23	5.4	1.6		18:08	5.9	1.8		18:58	3.3	1.0
	23:22	16.1	4.9	JULY 26	00:02	14.3	4.4	AUG 11	00:57	16.0	4.9
JULY 11	06:23	-0.6	-0.2		06:53	1.3	0.4		07:33	0.2	0.1
	12:42	12.1	3.7		13:07	12.6	3.8		13:42	14.9	4.5
	18:18	4.8	1.5		18:48	5.4	1.6		19:48	2.8	0.9
JULY 12	00:12	16.4	5.0	JULY 27	00:37	14.4	4.4	AUG 12	01:42	15.6	4.8
	07:08	-0.8	-0.2		07:23	1.2	0.4		08:13	0.9	0.3
	13:27	13.7	4.2		13:37	12.9	3.9		14:22	15.2	4.6
	19:08	4.2	1.3		19:23	5.0	1.5		20:33	2.6	0.8
JULY 13	01:07	16.4	5.0	JULY 28	01:12	14.4	4.4	AUG 13	02:32	14.7	4.5
	07:53	-0.7	-0.2		07:53	1.3	0.4		08:48	1.9	0.6
	14:07	14.1	4.3		14:02	13.2	4.0		14:57	15.1	4.6
	19:58	3.8	1.2		19:58	4.7	1.4		21:23	2.7	0.8
JULY 14	01:57	15.9	4.8	JULY 29	01:47	14.1	4.3	AUG 14	03:17	13.7	4.2
	08:38	0.0	0.0		08:23	1.7	0.5		09:28	3.2	1.0
	14:52	14.4	4.4		14:32	13.5	4.1		15:37	14.8	4.5
	20:53	3.7	1.1		20:33	4.5	1.4		22:13	3.1	0.9
JULY 15	02:47	15.0	4.6	JULY 30	02:22	13.7	4.2	AUG 15	04:07	12.5	3.8
	09:18	1.0	0.3		08:48	2.2	0.7		10:03	4.5	1.4
	15:37	14.5	4.4		15:02	13.7	4.2		16:17	14.3	4.4
	21:48	3.8	1.2		21:13	4.4	1.3		23:08	3.7	1.1
				JULY 31	03:02	13.1	4.0				
					09:18	2.9	0.9				
					15:32	13.8	4.2				
					21:53	4.3	1.3				

Figure 4: 1991 TIDE HEIGHTS (m)



APPENDIX 2. Estimated daily sockeye abundance by year.

	1967*			1968			1969			1970			1971		
VESSEL	Cape Sea II			Cape Sea II			Miss Robyn			Miss Robyn			Miss Robyn		
SOUNDER	Furuno 701 "Midget"			Furuno 860A			Furuno 701 "Midget"			Furuno 701 "Midget"			Furuno FM 21/22		
FREQUENCY	50 kHz			50 kHz			50 kHz			50 kHz			50 kHz		
DATE	MISS ROBYN	R.D. 102	TOTAL	MISS ROBYN	R.D. 102	TOTAL	MISS ROBYN	R.D. 102	TOTAL	MISS ROBYN	R.D. 102	TOTAL	MISS ROBYN	R.D. 102	TOTAL
JUNE 28/29										407		407			
29/30										124		124			
30/1										1405		1405			
JULY 1/2							3603		3603	1099		1099			
2/3							2755		2755	1965		1965			
3/4							2646		2646	1205		1205			
4/5							1688		1688	2691		2691	11305		11305
5/6				15381		15381	1915		1915	2366		2366	12217		12217
6/7				12560		12560				1125		1125	9436		9436
7/8	126094		126094							1085		1085	5358		5358
8/9	114287		114287				4328		4328	1538		1538	5116		5116
9/10							3161		3161	1306		1306			
10/11							7651		7651	1802		1802			
11/12				41442		41442	7537		7537	2291		2291	7956		7956
12/13				58498		58498	13204		13204	5876		5876	13709		13709
13/14	97621		97621	61079		61079				3257		3257	11880		11880
14/15	95861		95861	66305		66305				3989		3989	31793		31793
15/16	96161		96161				58403		58403	4004		4004	13041		13041
16/17							58630		58630	4251		4251			
17/18				124212		124212	59512		59512	1357		1357	118998		118998
18/19				107976		107976	62261		62261	1005		1005	201911		201911
19/20				122264		122264	21504		21504	1123		1123	248797		248797
20/21				98621		98621				8927		8927	262288		262288
21/22	201663		201663							13394		13394			
22/23	233442		233442				49022		49022	20847		20847	346633		346633
23/24	160617		160617				58084		58084	21293		21293	351326		351326
24/25							42301		42301	19916		19916	358499	30609	389108
25/26							34003		34003	22840		22840	314107	17232	331339
26/27							41425		41425	15858		15858	315732		315732
27/28				80185		80185				23515		23515	358191		358191
28/29	193199		193199	49152		49152				26068		26068	412411		412411
29/30	107095		107095	43387		43387	22228		22228	28828		28828	333764		333764
30/31	81185		81185	46823		46823	20587		20587	28170		28170	333949		333949
31/1				36584		36584	7268		7268	25185		25185	157597		157597
AUG 1/2				43793		43793	5501		5501	15563		15563	67595		67595
2/3				42545		42545				7525		7525	53976		53976
3/4				27443		27443				5334		5334			
4/5	43768		43768	27562		27562									
5/6	96811		96811												
6/7	35894		35894												
ESCAPEMENT		435250			555000			226000			102250			215900	
CATCH		1102838			2665792			727330			19019			402538	
TOTAL STOCK		1538088			3220792			953330			121269			618438	

* 1967 sounding conducted during daylight hours

APPENDIX 2 (cont.). Estimated daily sockeye abundance by year.

	1972			1973			1974			1975			1976		
VESSEL	Miss Robyn			Miss Robyn			Thrasher Rock			Thrasher Rock			R.D. 102		
SOUNDER	Furuno FM 21/22			Furuno FM 21/22			Furuno FM 21/22			Furuno FM 21/22			Furuno FM 21/22		
FREQUENCY	50 kHz			50 kHz			50 kHz			50 kHz			50 kHz		
DATE	MISS ROBYN	R.D. 102	TOTAL	MISS ROBYN	R.D. 102	TOTAL	MISS ROBYN	R.D. 102	TOTAL	MISS ROBYN	R.D. 102	TOTAL	MISS ROBYN	R.D. 102	TOTAL
JUNE 28/29															
29/30															
30/1															
JULY 1/2				2762		2762									
2/3				3460		3460									
3/4	5656		5656	6715		6715									
4/5	17272		17272	1924		1924									
5/6	14811		14811	13419		13419									
6/7	21153		21153	10629		10629									
7/8	23142		23142	3238		3238									
8/9				2990		2990									
9/10				8472		8472									
10/11	59209		59209	21965		21965									
11/12	98596		98596	23981		23981									
12/13	153600		153600		73200	73200									
13/14	118478		118478	18537		18537	3634		3634						
14/15	105138		105138	139211		139211	2677		2677						
15/16	121203		121203				3427		3427		5689	5689			
16/17	143964		143964				16141	24620	40761						
17/18	182539		182539	359475	101339	460814	49057	8909	57966		32315	32315			
18/19	238523		238523	509923	35112	545035	59610	7491	67101	853	23111	23964	166481		166481
19/20	218058		218058		304618	304618	94467		94467		17706	17706	143070	139112	282182
20/21	229917		229917		233685	233685	110220		110220						
21/22	244797		244797	464815		464815	120500	17136	137636	48498	19442	67940	291208		291208
22/23	226016		226016				126960	27705	154665	57979		57979			
23/24	267679		267679				135146	34187	169333	48235	58446	106681			
24/25	212893		212893							81657		81657	270541		270541
25/26	321799		321799							109867	67011	176878			
26/27	299230		299230							86088		86088			
27/28	273795		273795							52822	27113	79935	283760		283760
28/29	261724		261724							74478		74478	287954		287954
29/30										49541		49541			
30/31	205400		205400												
31/1	174583		174583							50474		50474			
AUG 1/2	117911		117911							34559		34559	248502		248502
2/3															
3/4															
4/5															
5/6															
6/7															
ESCAPEMENT		221500			985000			557025			480002			300000	
CATCH		379006			1761376			118704			40631			613666	
TOTAL STOCK		600506			2746376			675729			520633			913666	

APPENDIX 2 (cont.). Estimated daily sockeye abundance by year.

	1977			1978			1979			1980			1981		
VESSEL	Walker Rock			Walker Rock			Walker Rock			Walker Rock			Walker Rock		
SOUNDER	Furuno FM 21/22			Furuno FM 21/22			Furuno FM 21/22			Furuno FM 21/22			Furuno FM 21/22		
FREQUENCY	50 kHz			50 kHz			50 kHz			50 kHz			50 kHz		
DATE	MISS ROBYN	R.D. 102	TOTAL	MISS ROBYN	R.D. 102	TOTAL	MISS ROBYN	R.D. 102	TOTAL	MISS ROBYN	R.D. 102	TOTAL	MISS ROBYN	R.D. 102	TOTAL
JUNE 28/29															
29/30										693	2951	3644			
30/1															
JULY 1/2										1748	3138	4886			
2/3															
3/4											2110	2110			
4/5															
5/6															
6/7															
7/8										10266	12399	22665			
8/9				37502		37502									
9/10				38819		38819				7106	42508	49614			
10/11	35278		35278	35060		35060	16150		16150						
11/12		18445	18445	38621		38621	11853	20131	31984				89798		89798
12/13				85976		85976	20001		20001	139532	38390	177922		182512	182512
13/14							18015		18015	174680	59730	234410	54174	115688	169862
14/15	60482		60482	90371		90371	30227	23377	53604	152221	82148	234369	120135		120135
15/16		37875	37875	63052		63052				160847	108513	269360		143812	143812
16/17				73782		73782	40723	50223	90946	207716	72453	280169	191571		191571
17/18	140294	51386	191680	86240		86240	87020		87020	202088	82660	284748	261467	145687	407154
18/19	167247	57245	224492				109179		109179	207835	82544	290379	304571		304571
19/20	204182	28213	232395	114890	17269	132159	161870		161870				393969	176054	570023
20/21	180760		180760	136295	17540	153835	196927		196927	207527	88284	295811	406794	101303	508097
21/22		76608	76608	120641		120641	210317		210317				427260	202959	630219
22/23	236672	25862	262534	166115		166115	217650	107845	325495	96556	66277	162833	474338	254607	728945
23/24	220882		220882				235744		235744				561430	178012	739442
24/25	254821		254821	120854		120854	171089	57293	228382				682160	94666	776826
25/26	211217	12907	224124	91776		91776							593311	28499	621810
26/27													562227	20770	582997
27/28				61018		61018									
28/29													369885		369885
29/30															
30/31															
31/1															
AUG 1/2	59685														
2/3															
3/4															
4/5															
5/6															
6/7															
ESCAPEMENT		191600			383000			297525			313000			753075	
CATCH		660469			568682			28349			522			98706	
TOTAL STOCK		852069			951682			325874			313522			851781	

APPENDIX 2 (cont.). Estimated daily sockeye abundance by year.

	1982			1983			1984			1985			1986		
VESSEL	Walker Rock			Walker Rock			Walker Rock			Walker Rock			Walker Rock		
SOUNDER	Furuno FM 21/22			JRC Model JFF 111			JRC Model JFF 111			JRC Model JFF 111			Simrad EY-M		
FREQUENCY	50 kHz			50 kHz			50 kHz			50 kHz			70 kHz		
DATE	MISS ROBYN	R.D. 102	TOTAL	MISS ROBYN	R.D. 102	TOTAL	MISS ROBYN	R.D. 102	TOTAL	MISS ROBYN	R.D. 102	TOTAL	MISS ROBYN	R.D. 102	TOTAL
JUNE 28/29															
29/30															
30/1															
JULY 1/2															
2/3															
3/4															
4/5															
5/6															
6/7															
7/8															
8/9															
9/10								20708	20708					22278	22278
10/11	7333	45338	52671		9967	9967	15000	62808	77808				26438	22068	48506
11/12	10158	49103	59261		36334	36334	25770	196490	222260				63206	27064	90270
12/13		48112	48112	80617	30851	111468	13214	126182	139396				47105	29349	76454
13/14	13575	50441	64016	45812	43129	88941	47824	119774	167598				43811	25945	69756
14/15		131286	131286	23049	72903	95952	174688	58777	233465	10129	9459	19588	65858	53582	119440
15/16		123245	123245	23291	104450	127741	259860	39553	299413	36617	10678	47295	99367	147907	247274
16/17		95059	95059	59709	128739	188448	341461	52492	393953	55818		55818	43269	105201	148470
17/18	30780	116453	147233	111849	76285	188134	299198	105830	405028	99293	24002	123295	53228	117315	170543
18/19	29220	145207	174427	147560	64061	211621	286400	97806	384206	134154	16396	150550	60637	191970	252607
19/20	75123	229760	304883	172442	95798	268240	384670	99535	484205				79698	102012	181710
20/21	129000	189856	318856	218935	76010	294945	356323	28761	385084	74896	15257	90153	119590	141590	261180
21/22	123362	152755	276117	252687	178674	431361	339467	22089	361556	96430	22363	118793	114155	101035	215190
22/23	174700	106362	281062	237990		237990	315730	30926	346656	110875	22257	133132	88890	149583	238473
23/24	204516	71813	276329	228469		228469	308928	34052	342980	97288	19630	116918	176436	122662	299098
24/25	160621	63128	223749	201351	36280	237631	465011			78636	10747	89383	180361	90311	270672
25/26							373492			71918	12508	84426	278943	39758	318701
26/27															
27/28															
28/29															
29/30															
30/31															
31/1															
AUG 1/2															
2/3															
3/4															
4/5															
5/6															
6/7															
ESCAPEMENT		823000			636502			214301			500430			825626	
CATCH		39178			35160			53879			184544			337374	
TOTAL STOCK		862178			671662			268180			684974			1163000	

APPENDIX 2 (cont.). Estimated daily sockeye abundance by year.

	1987			1988			1989			1990			1991		
VESSEL	Walker Rock			Walker Rock			Walker Rock			Walker Rock			Walker Rock		
SOUNDER	Simrad EY-M			Simrad EY-M			Simrad EY-M			Simrad EY-M			Simrad EY-M		
FREQUENCY	70 kHz			70 kHz			70 kHz			70 kHz			70 kHz		
DATE	MISS ROBYN	R.D. 102	TOTAL	MISS ROBYN	R.D. 102	TOTAL	MISS ROBYN	R.D. 102	TOTAL	MISS ROBYN	R.D. 102	TOTAL	MISS ROBYN	R.D. 102	TOTAL
JUNE 28/29															
29/30															
30/1															
JULY 1/2															
2/3															
3/4															
4/5															
5/6															
6/7				5401	6742	12143									
7/8	*	0	*	58261	9909	68170									
8/9	2314	1086	3400	19854	28408	48262									
9/10	*	899	* 899	784	9408	10192									
10/11	* 978	1061	* 2039	206	2813	3019							0	0	0
11/12	2587	3976	6563	1355	3065	4420							0	0	0
12/13	2331	18545	20876	453	16374	16827	0	271	271	2655	1550	4205	0	434	434
13/14	18086	24009	42095	1399	252377	253776	437	3141	3577	13481	12468	25949	139	414	553
14/15	47505	24642	72147	2273	157270	159543	1442	3932	5375	13045	42567	55612	2298	1149	3447
15/16	32129	48382	80511	0	62589	62589	4237	2660	6897	9598	40560	50158	1412	0	1412
16/17	9837	49368	59205	158	24853	25011	2834	13780	16614	12242	38834	51076	2559	17745	20304
17/18	3165	47707	50872	0	7613	7613	1531	4170	5701	42115	111815	153930	18501	4749	23250
18/19	7758	32326	40084	0	52196	52196	6218	1683	7901	32756	128374	161130	17047	1291	18338
19/20	39901	37688	77589	15971	267625	283596	6874	5126	12000	43665	126856	170520	13052	1218	14270
20/21	88976	68861	157837	137163	518922	656085	17870	5398	23269	50504	104815	155319	23137	8078	31215
21/22	188161	164182	352343	124205	824647	948852	21053	5237	26290	87039	118845	205884	12297	16787	29084
22/23	108555	139053	247608	155241	625064	780305	117956	12105	130061	152888	145859	298747	34746	17970	52716
23/24	188742	152515	341257	20953	412971	433924	93639	26486	120125	234781	139557	374338	85657	36066	121723
24/25	234372	109358	343730	3389	480408	483797	123098	57419	180517	131339	160933	292273	199298	10467	209765
25/26	75796	97335	173131	321361	631529	952890	140790	53405	194195	196274	113742	310017			
26/27	50754	98536	149290	704908	208646	913554	172257	41331	213588						
27/28				963007		963007									
28/29															
29/30															
30/31															
31/1															
AUG 1/2															
2/3															
3/4															
4/5															
5/6															
6/7															
ESCAPEMENT		521700			503000			375175			586500			NA	
CATCH		398863			372025			63751			232346			152241	
TOTAL STOCK		920563			875025			438926			818846			NA	

* Miss Robyn grid not completely sounded